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I am aware that this is similar to the experiments made by Passed Assistant Surgeons Rosenau and Sprague some years ago with formaldehyd gas in the Kinyoun-Francis apparatus, but here the same results are claimed without the use of the partial vacuum. M. Fournier has also an autoclave with an "omnibus" door, that will replace any door, by means of which he can raise the temperature of an ordinary room to 40 or 42°, and with the gas completely disinfect in six hours.

As will be seen from the illustrations on pages 13 and 15, this apparatus appears rather complicated, especially as a fan or turbine (operated also from without) is required to circulate the heated air and gas.

Bactericidal power of formacétone.

As to the details of the bactericidal powers of this process no official tests of its powers to disinfect habitations have been made as yet with the approved apparatus—i. e., furnishing the added element of heat. However, the same process without heat was tested by Drs. Du Bois, St. Servin, and Bonnefoy, of the French navy, at the laboratory of bacteriology of the naval hospital of Lorient, and a report of the same appeared in the December, 1899, number of the "Archives de Medicine Navale." In these tests the solution used consisted of acetone, two-fifths, 40 per cent; formaldehyd, three-fifths. The walls were sponged with a 2 per cent solution of same and the floor sprinkled with a 50 per cent solution before beginning. Then an injection was made of pure acetone gas and afterwards with the "formacétone" gas and the rooms left closed for from thirty-six to forty hours. The conclusions drawn were that the process was "efficacious but not absolute," that a certain degree of penetration through a cloth and paper was shown. Excepting this, however, the results correspond in general to those obtained from formaldehyd, while on the other hand it deals with a dangerous explosive gas.

M. Fournier tells me that a new test will soon be made before a committee of the academy of sciences, and that a copy of the report will be furnished me.

The fourth exhibitor of disinfecting apparatus mentioned shows principally smaller appliances that would probably not be of special interest to the Bureau.

Review of the French literature on disinfection by formic aldehyde.

[By Asst. Surg. S. B. Grubbs.]

The actual condition of disinfection by formaldehyd gas in France is that of a deadlock—that is, the chemists and bacteriologists interested in the process, and many disinterested ones, have made numerous experiments and shown results from which they claim that the gas used by what is known here as the "procédé Trillat" supplies easy, cheap, quick, and harmless surface disinfection.

The majority of scientists in official stations, on the other hand, claim that the gas is not efficacious; that the process is complicated and presents no improvement over the one now used by the municipal disinfection service, viz, spraying with a solution of bichloride of mercury.

Probably on account of this deadlock the literature on this subject has not been extensive since the publication in 1896 of M. Trillat's book "La Formaldéhyde." A glance at several articles, however, showing both sides of the question, may be of interest.

First, a short report entitled "*Experiments on disinfection by the vapors of formaldehyd.*" Made at Lille by M. Trillat.

After mentioning the method formerly used, namely, the generation

of formaldehyd vapors from methyl alcohol by means of a lamp, process which must now be entirely abandoned the formogene autoclave is described and formo chloral (mixture of formalin and calcium chlorid) mentioned as the solution to be used. That vapor must be under pressure is insisted upon, in order to get as dry a gas as possible—an absolutely dry gas is not thus possible or desired. Formaldehyd acts as a disinfectant by its action upon all albuminous matter. It renders albumin and gelatin insoluble acting even on diastase, pepsin, peptone, etc., but to a slighter degree. To disinfect, a large quantity of gas must be produced rapidly, first, to save time; second, as this dry vapor polymerizes rapidly, the slow saturating of a large space is impossible. Time beyond that necessary to introduce the vapors into the rooms appears of little value.

First experiment.—Large room, 110 cubic meters (3,800 cubic feet). Temperature, 3° C. Time, twenty-eight minutes to get pressure, gas allowed to pass twenty minutes. Then after fifteen minutes all windows and doors opened; so the whole exposure was but thirty-five minutes, and allowing ten minutes for aëration, the whole operation occupied less than one hour and a quarter. Result, bacteria staphylococcus, streptococcus plague, cholera Massacouah, typhoid, diphtheria, as well as 12 cultures of anthrax spores all freely exposed at various places and various heights were all found to be sterile. Several cultures of plague placed on a bed and the bedclothes thrown loosely over them were also sterilized.

Second experiment.—Size of hall 436 cubic meters (15,060 cubic feet). The temperature was 10° C. Thirty minutes to get pressure of 4 atmospheres. Gas was allowed to enter forty minutes, and fifteen minutes later the hall was aired. About the same bacteria were used, except the anthrax spores. They were freely exposed on paper or cloth and all were found to be sterile after the operation. The time of the entire operation was one hour and twenty-five minutes. Besides in this test dust impregnated with diphtheria bacilli and dried was placed in several Petri dishes in a layer one-half centimeter thick. After exposure as above this dust was planted in 8 bouillon tubes. After forty-eight hours 6 of these tubes contained only pure cultures of bacillus subtilis.

Again, a square of linen dipped in tubercular sputum and dried, failed to infect guinea pigs, on being introduced whole into abdominal cavities.

The conclusions drawn from these experiments are:

First. Anthrax spores can be sterilized in room of over 100 square meters by less than one hour exposure to formaldehyd gas.

Second. A room of 436 meters cube was sterilized in one hour and a half.

Third. In this experiment both diphtheria and tubercular bacilli mixed with dust were killed.

It is interesting to note that in these experiments no attempt was made to seal doors or windows. The rooms were closed as tightly as possible, but no cotton put in cracks or paper pasted over them.

In an article on disinfection by the vapors of formic aldehyd published in 1897, Dr. C. Nicolle cites several experiments from which he draws very favorable conclusions. These experiments can be given briefly thus:

First. Room 37 cubic meters (1,278 cubic feet) test on 4 germs, including anthrax spores dried on pieces of paper, autoclave operated three hours, and used 3 liters of solution. Cultures planted as soon as gas shut off, and again after fourteen hours. Sterilization complete.

Second. Large hall and annex, 1,400 meters cube (48,256 cubic feet), autoclave operated five hours and used 9 liters of solution. Same cultures as above, planted thirty-six hours after, remained sterile. Bacteriological examination of air of hall before test showed 49,400 germs per square meter, afterwards two or three. Dust of the hall (depth not stated) planted, gave growths of *bacillus subtilis* and *mesentericus*.

Third. Ward in contagious hospital at Montpellier, autoclave operated two hours, consuming 4 liters of solution. There were tested many bacteria, including diphtheria, *bacterium coli*, and anthrax spores, also pus and dried tubercular sputum. Sterilization was absolute, although the cultures were distributed at every possible distance and height, and a culture of *staphylococcus* was put inside a pantaloone pocket and a culture of *coli bacillus* between a folded mattress. Tubercular sputum dried to the thickness of one millimeter, inoculated into a guinea pig after exposure, failed to give any manifestations.

Fourth. Ward 600 cubic meters (20,725 cubic feet), 15 liters of solution used and tests made after six and twenty-four hours exposure. Results as above, except *bacillus* of malignant oedema and tetanus were not killed, and the *bacillus subtilis* could be easily obtained from the dust of the room.

The experiment, the subject of this article, is then described. It was made in the bacteriological laboratory in four communicating rooms of 218 cubic meters (7,470 cubic feet) capacity. Pieces of linen 1 centimeter square were dipped in various cultures, eight in all, including anthrax spores, dried and placed in various parts of the rooms. Besides there were exposed Arloing's powder (vaccination for symptomatic anthrax), pus (*staphylococcus*), diarrhea stools, and tuberculous sputum. All specimens were arranged so as to allow free contact of the gas.

Two liters of solution were used, equaling about 600 grains of pure formic aldehyd. Temperature of room, 9° C.; autoclave operated one hour and ten minutes. First test of cultures was taken twenty minutes later and the rooms left closed eighteen hours, after which the second lot of cultures was taken.

The cultures, pus, etc., were planted in the most favorable media. Arloing's powder was injected into a guinea pig after being mixed with a solution of lactic acid. Tubercular sputum was mixed with bouillon and injected intraperitoneally. All cultures remained sterile; even those inoculated with pus and fecal matter exposed. The guinea pigs injected as above remained healthy. To determine if sufficient formic aldehyd to hinder growth was carried to the bouillon by the pieces of gauze, several of the tubes thus remaining sterile were reinoculated with the same germ living. All grew immediately.

It must be noted that in the above experiment, no attempt was made at penetration, all specimens being exposed to light (during several hours) as well as to the gas.

From these and the previous experiments mentioned Dr. Nicolle draws the following conclusions: "The sterilization of living quarters by the vapors of formic aldehyd produced by the autoclave of M. Trillat, is a process of sterilization practically absolute since outside of certain very resistant, nonpathogenic germs, and the *bacillus* of tetanus, and the *bacillus* of malignant oedema (experiments of M. Vaillard) it destroys all the pathogenic microbes. It is in all events infinitely superior to the processes at present employed for purposes of disinfection, viz, vapors of sulphur and sprays of a solution of sublimate."